Chemicals in Drinking Water

Grades	Subjects	Duration
8 - 10	Chemistry and/or Environmental Science	One to two class periods

Materials

- "Drinking water" solution
  - Distilled water
  - NaCl – to represent a contaminant
  - Other non-hazardous soluble elements or inorganic compounds as you choose
- Graduated cylinders
- Burners or hot plates
- Ring stands if using burners
- Matches if using burners
- 1,000 ml beakers
- 250 ml beakers
- tongs
- hot pads
- scales
- EPA's MCL list (www.epa.gov) or (http://www.epa.gov/safewater/mcl.html) overhead, focus on inorganics
- Copies of lab sheet
- Overhead of Consumer Confidence Report from your Public Water System

Objective

The student will be able to separate contaminants from a "drinking water" solution and accurately determine the mass of the contaminant per unit volume of water.

The student will compare the concentration of their contaminant to the EPA drinking water standards in order to determine if the contaminant poses a threat to human health.

The student will be able to explain the adverse health effects of their contaminant, as well as sources for the contaminant.

The student will identify and understand methods of treating or removing the contaminant from drinking water.

Set

One option for an introduction to this lesson is a field trip to a water treatment plant (preferably drinking water, but wastewater is valuable as well). Alternatively, a visit to an analytical laboratory could be substituted. An additional realistic introduction to this lesson would be to invite an analytical chemist as a guest lecturer.

Have the students pick up and preview a lab sheet as they enter the class.

Ask the class to hold up their hands if they think their drinking water is safe for consumption. Ask those that do not raise their hands why they think the drinking water in your town may not be safe. Many will respond that the water contains various types of pollution. Ask them if they know of any specific pollutants that might be in drinking water and if they know the sources of the pollution. Ask if drinking water must be totally absent of contaminants in order to be considered safe.

Show the overhead of the EPA's MCLs for drinking water. Point out the extremely small quantities of contaminants that can be present in water, for it to be considered unsafe to drink. Inform the student that they will be engaged in a lab designed to test the quality of a hypothetical sample of drinking water.

Instructional Input

Go over the lab procedure with the students.

Conduct the lab.

See "Closure."

Guided Practice

See the lab sheet.

Evaluation

See the lab key. You may assign point values as you see fit.

Closure

Obtain a copy of the Consumer Confidence Report from your local Public Water System. Analyze the report with the class (overhead) and compare the results of water sample analysis with the EPA Drinking Water Standards. Discuss any areas of potential concerns or MCL violations. What are some of the potential contaminant sources, health effects of contaminants in your drinking water, and treatment methods for any contaminants in your water? (**http://www.cyber-nook.com/water/concerns.html** is a good place to start to identify treatment methods)

Resources

1. Fill an appropriate number of 1,000-ml beakers with 1,000 ml of distilled water. The number of beakers should equal the number of lab groups you will have in your class. Label each beaker with a unique code.
2. Measure out a given amount of "contaminant" and dissolve in the beaker of water. Make sure you keep a table of beaker codes, concentration of contaminant (mg/L), and the type of contaminant you are simulating for each beaker.
3. Cover to prevent evaporation if leaving over night.
4. Make sure you have the requisite sets of lab materials (see lab sheet)

Most scales available to schools will not be sensitive enough to measure milligrams of the solutes you add to the water. I suggest using 0.5 g or more of solute (NaCl or sugar works well) if your scales can accurately and precisely measure this amount. **No not merely use your school's tap water!** Your equipment will not be sensitive enough to measure any contaminants that might be present.

Keep in mind that the students will take the tare mass of their empty beakers, pour in the "drinking water," boil the water off, and then weigh the beaker and contaminant in order to determine the mass of the contaminant before calculating its concentration in the water. Of course the concentration will be many orders of magnitude higher than what would normally be found in safe, and even unsafe, drinking water. This is addressed in the follow up lab questions. The solute/contaminant you use is up to you; you may even want to use different kinds. The important thing to remember is that you are simulating actual drinking water contaminants. It

would not be safe to use mercury, lead, or arsenic; consequently it is suggested that teachers substitute safer contaminants. These substitutions will represent the more dangerous contaminants found in drinking water.